

Effect of a Text-Messaging Intervention on Oral Self-Care Practices in Antenatal Women in Delhi, India: A Pilot Randomized Control Trial

Saurav Basu, Anjali Rajeev, Suneela Garg, Mongjam Meghachandra Singh

Department of Community Medicine, Maulana Azad Medical College, New Delhi, India

Abstract

Objective: This study aimed to determine the effect of a mHealth (text message) intervention compared with a structured health educational session on the oral care and hygiene practices of pregnant women. **Materials and Methods:** We conducted a pilot randomized control trial, parallel design superiority trial, with a 1:1 allocation ratio. A total of 76 pregnant women up to 20 weeks of gestational age and capable of reading mobile phone text messages were recruited during August–October 2020 from the antenatal clinic of a primary health center in a low-income urban agglomeration in Delhi, India. The mHealth intervention arm participants were sent a daily text message for 30 days, while all participants were provided a one-time, face-face, brief didactic structured educational session toward oral health promotion. **Results:** The baseline characteristics of both groups were comparable in terms of age structure, education, parity, and oral hygiene but differed in terms of oral health problems. Postintervention, although the twice-brushing frequency increased in both arms, only the mHealth arm revealed a statistically significant reduction in the incidence of missed twice-daily brushing episodes ($P = 0.016$). **Conclusions:** A mHealth-based daily text-message intervention for 1 month was not superior to a one-time brief didactic structured educational intervention for oral health promotion in antenatal women.

Keywords: Antenatal care, dental health education, dental health promotion, mHealth

INTRODUCTION

Hormonal fluctuations during pregnancy increase the risk of periodontal impairment, contributing to adverse pregnancy outcomes including prematurity, low birth weight, and preeclampsia.^[1,2] Several countries include oral health care as an essential component of antenatal care services.^[3] However, in India, most pregnant women fail to access oral health-care services during pregnancy due to limited awareness, accessibility, and affordability.^[4,5] Furthermore, a high prevalence of poor oral hygiene including the absence of twice-daily brushing has been observed in antenatal women, especially those belonging to the lower socioeconomic classes.^[6]

There is growing recognition of the application of mHealth (mobile health) technology through educational text messages and voice calls for improving antenatal health utilization and outcomes in vulnerable populations.^[7,8] India has the second-highest mobile phone connectivity in the world with high mobile phone density which makes it ideal for utilizing

the mHealth platform, but there is limited evidence of its effectiveness toward oral health promotion.^[9]

We thereby conducted this study with the objective of determining the effect of a mHealth (text message) intervention compared with a structured health educational session on the oral care and hygiene practices of pregnant women.

MATERIALS AND METHODS

We conducted a randomized control trial, parallel design superiority trial, with a 1:1 allocation ratio. The participants

Address for correspondence: Dr. Saurav Basu,
Department of Community Medicine, Maulana Azad Medical College,
New Delhi, India.
E-mail: saurav.basu1983@gmail.com

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were recruited from a government urban primary care antenatal clinic located in Delhi, India, providing services to a low-income urban resettlement colony and slum population with an estimated ~30,000 population.

All adult pregnant women of gestational age up to 20 weeks of age providing consent to receive health information via text messages were enrolled in this study. The women who were unable to read text messages or lacking access to a mobile phone were excluded. As part of standard care at the antenatal clinic, the pregnant women were counseled regarding recommended self-care during pregnancy, but this did not include health education for oral health and hygiene promotion. Consequently, all the study participants received a one-time, face-face, brief didactic structured educational session toward oral health promotion. In addition, the mHealth intervention arm participants were provided a daily text-message (SMS) package for 30 days. The pregnant women fulfilling the eligibility criteria were enrolled consecutively, with a maximum of nine eligible participants enrolled on a single clinic day.

The primary study outcomes were (i) the change in the habit of twice-daily brushing measured as the proportion of women practicing twice-daily brushing and (ii) change in the dental self-efficacy (DSE) for twice-daily brushing. The secondary study outcomes were (i) interdental cleaning practice and (ii) attitude toward oral hygiene during pregnancy.

A total of 76 women considered adequate for pilot studies^[10] were enrolled in this study with 38 participants each in the text-message SMS (mHealth) intervention and the comparison arm, respectively.

The first investigator generated a random sequence for allocation of the participants into the different intervention arms using a computer generated random number list in a 1:1 allocation into either the mHealth intervention or the comparison arm using random block sizes of 2 and 4. Participant enrolment was conducted by the second investigator. Allocation concealment was performed by the sequentially numbered, opaque, sealed envelope method. Blinding of study participants was not possible in the study design. However, to minimize bias, the person doing the data entry did not participate in the data analysis. Furthermore, posttest interviews of the women were conducted by a trained field investigator who was not part of the investigation team.

Study instruments

1. Interview schedule: Sociodemographic details, pregnancy details (GPLA), oral self-care knowledge and attitudes, perceived teeth and gum status, health-care seeking, and oral hygiene practice (brushing habit and frequency, interdental cleaning) adapted from the World Health Organization step module on oral health^[11]
2. DSE for twice-daily brushing: Modified from the original questionnaire by Knecht *et al.*^[12] into a 3-item scale and linguistically validated into Hindi using a standard back

and forth translation process. Cronbach's alpha of the 3-item DSE was 0.851, indicating good reliability.

An investigator assessed the antenatal clients visiting the clinic and those meeting the eligibility criteria were recruited in this study. Data were collected using the pretest interview schedule at baseline. Posttest outcomes were assessed in all the participants 15–30 days after completion of the 30-day text-message intervention. A telephonic follow-up was conducted if the participants did not report to the antenatal clinic within 15 days of their scheduled monthly appointment after the due date of their postintervention outcome assessment.

Study interventions

Both the intervention and the comparison arms received a brief, didactic, structured educational intervention using focused awareness and motivation approaches for oral health promotion from a resident community medicine physician. The educational interview lasted 3–4 minutes and was delivered by a trained female investigator. She educated the women on the importance of oral health care through three key messages. First, the importance of oral health during pregnancy and its impact on the health of the mother and her baby. Second, the recommended oral self-care practices with emphasis on twice-daily brushing and the correct steps towards brushing one's teeth. Third, scheduling a bi-annual checkup with a dental health professional irrespective of the presence of symptoms.

The mHealth (text-message SMS) arm received oral health education through a daily text message for 30 days in the local language Hindi. The text-message intervention package included 15 unique text messages that focused on the promotion of oral self-care and prevention of oral health problems based on the health belief model of behavior change.^[13] These messages were created in consultation with public health specialists with experience in oral health research, and considering the background of suboptimal brushing practices prevalent in the local community. The messages were pretested in 10 pregnant women to assess comprehension. Moreover, there were 12 reminders for nighttime or twice-daily brushing incorporated within the text-message intervention package.

The data were analyzed in IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY, USA: IBM Corp. We complied with an intention to treat analysis for ascertaining the between- and within-group differences. $P < 0.05$ was considered statistically significant. The study was approved with exemption from full review by the Institutional Ethics Committee. The study was prospectively registered with the Clinical Trial Registry of India (CTRI/2020/03/024305). Written and informed consent was obtained from all study participants.

RESULTS

Seventy six pregnant women were randomized equally into a mHealth intervention ($n = 38$) and a comparator arm ($n = 38$) [Figure 1]. Fifteen participants were lost to follow-up including five in the mHealth and seven in the comparator arm. The

recruitment of participants was conducted for a duration of 3 months from August to October 2020 during 10 antenatal clinic days and follow-up from October to November 2020.

Baseline characteristics

Table 1 depicts the sociodemographic characteristics of the study participants ($n = 76$). All the participants practised daily brushing with brush and toothpaste. Only 6 (7.7%) participants reported receiving dental care during their current pregnancy. At baseline, both the study arms were comparable in terms of age structure, education, parity, and oral brushing hygiene [Table 1].

Intervention utilization and effectiveness

The utilization of the text message intervention in the mHealth arm was reported by 15 (45.4%) participants who regularly read the SMS text messages ($n = 33$). The participants who did not read the text messages attributed

it to limited access to a shared mobile phone in their households which was also used by their husbands and other family members.

The absolute effect size for the primary outcome signifying the difference in the proportion of participants reporting twice-daily brushing frequency habit between the mHealth and comparison arms was 0.090, the Cohen's H was 0.182, and the odds of twice-brushing habit in the mHealth arm was 1.44 times higher than in the comparison arm.

The proportion of participants reporting twice-daily brushing frequency habits was higher in the mHealth compared to the comparison arm, but this difference was not statistically significant ($P = 0.43$). Although the twice-brushing frequency increased in both the study arms, only the mHealth arm revealed a statistically significant reduction in the incidence of missed twice-daily brushing episodes in the previous 7 days ($P = 0.016$). Participants in the mHealth arm also reported an improvement in the perceived attitudes toward oral health care during pregnancy ($P = 0.006$). Nevertheless, the DSE scores did not significantly vary postintervention in either arm [Table 2]. Furthermore, only three participants reported the practice of dental flossing postintervention, two in the mHealth intervention and one in the comparison arm.

The text-message intervention resulted in a statistically significant reduction in the incidence of missed episodes of twice-daily brushing in the mHealth arm participants below 25 years of age, and without preexisting dental complaints [Table 3].

On perprotocol analysis in the mHealth arm, among the participants who reported having read the text messages ($n = 15$), the twice-daily brushing habit increased from 66.7% (10/15) at baseline to 80% (12/15) postintervention ($P = 0.5$). The median (interquartile range) score for frequency of twice-daily brushing increased from 6 (0, 7) at baseline to 7 (3, 7) postintervention ($P = 0.042$).

DISCUSSION

In this study, the participants in both the study arms reported an improvement in the daily twice-brushing habit and frequency. However, in the mHealth arm, the benefit was greater in the comparatively younger and more educated participants in agreement with previous evidence suggestive of the more effective utilization of digital health interventions by those with priori adequate digital literacy.^[14,15]

The strengths of the study include its conduct in a resource-constrained real-world setting where oral health education was not imparted to pregnant women routinely. Moreover, it is one of the first studies which provide proof of concept for the effectiveness of these low-cost, scalable interventions for oral health promotion with applicability in the developing world.

Table 1: Baseline characteristics of the study participants

Characteristic	mHealth arm ($n=38$)	Comparison arm ($n=38$)	Total ($n=76$)
Age (years)	25.71±3.60	25.39±3.9	25.55±3.67
Education (years)	10.68±4.60	11.45±3.99	11.07±4.32
Gravida	2 (1-2)	1 (1-2)	2 (1-2)
Parity	1 (0-1)	1 (0-1)	0 (0-1)
Live birth	1 (0-1)	1 (0-1)	0 (0-1)
Teeth status			
Excellent	16 (42.1)	13 (34.2)	29 (38.2)
Very good	15 (39.5)	9 (23.7)	24 (31.6)
Good	4 (10.5)	8 (21.0)	12 (15.8)
Fair	3 (7.9)	8 (21.0)	11 (14.5)
Poor/very poor	0	0	0
Gum status			
Excellent	19 (50)	16 (42.1)	35 (46.1)
Very good	14 (36.8)	13 (34.2)	27 (35.5)
Good	0	5 (13.1)	5 (6.6)
Fair	5 (13.2)	4 (10.5)	9 (11.8)
Last dental visit			
<6 months	1 (2.6)	5 (13.1)	6 (7.9)
6-12 months	2 (5.2)	2 (5.2)	4 (5.3)
>1-<2 years	3 (7.9)	1 (2.6)	4 (5.3)
≥2-5 years	4 (10.5)	4 (10.5)	8 (10.5)
>5 years	5 (13.1)	6 (15.8)	11 (14.5)
Never	23 (60.5)	20 (52.6)	43 (56.6)
Oral complaints	9 (23.7)	19 (50)	28 (36.8)*
Brushing frequency			
Once	17 (44.7)	20 (52.6)	37 (48.7)
Twice	21 (55.3)	18 (47.4)	39 (51.3)
Tongue cleaning			
Never	10 (26.3)	5 (13.2)	15 (19.7)*
Sometimes	3 (7.9)	10 (26.3)	13 (17.1)
Often	25 (65.8)	23 (60.5)	48 (63.2)
Dental self-efficacy [†]	$n=21$	$n=18$	$n=39$
Median (IQR) score	10 (5-12)	9.5 (5.7-12)	10 (5-12)
Suboptimal (<12)	13 (61.9)	11 (61.1)	24 (61.5)

* $P<0.05$, [†]In those participants reporting twice-daily brushing.

IQR: Interquartile range

Table 2: Change in oral self-care practices (pre and postintervention)

Variable	mHealth arm		P	Comparison arm		P
	Baseline	End line		Baseline	End line	
Twice-daily brushing frequency*	n=33 17 (51.5)	20 (60.6)	0.250	n=31 13 (41.9)	16 (51.6)	0.250
Missed twice-daily brushing*	n=17 8 (47.1)	1 (5.5)	0.016	n=13 9 (69.2)	5 (38.5)	0.125
DSE score ⁺	10 (5-12)	9 (7-11)	0.123	9 (5.5-12)	9 (6.5-12)	0.200
Oral health attitude score ⁺	n=33 8 (7-8)	9.5 (9-10)	0.006	n=31 8 (7-10)	9 (8-10)	0.396

*McNemar test, ⁺Wilcoxon signed-rank test. DSE: Dental self-efficacy

Table 3: Change in twice-daily brushing frequency postintervention (n=33)

Variable	Missed twice-daily brushing*				P ⁺
	Baseline		End line		
	Yes	No	Yes	No	
mHealth intervention arm					
Age					
≤25	13 (68.4)	6 (31.6)	7 (36.8)	12 (63.2)	0.031
≥26	11 (78.6)	3 (21.4)	8 (57.1)	6 (42.9)	0.250
Education					
≤12	15 (78.9)	4 (21.1)	10 (52.6)	9 (47.4)	0.063
≥13	9 (64.3)	5 (35.7)	5 (35.7)	9 (64.3)	0.125
Parity					
Nil	9 (64.3)	5 (35.7)	6 (42.8)	8 (57.2)	0.250
≥1	15 (78.9)	4 (21.1)	9 (47.4)	10 (52.6)	0.031
State of teeth					
Excellent/very good	19 (73.1)	7 (26.9)	11 (42.3)	15 (57.7)	0.008
Good/fair	5 (71.4)	2 (28.6)	4 (57.1)	3 (42.9)	1.00
Pain while chewing					
Present	2 (50)	2 (50)	1 (25)	3 (75)	1.00
Absent	22 (75.9)	7 (24.1)	14 (48.3)	15 (51.7)	0.008
Educational intervention only					
Age					
≤25	14 (87.5)	2 (12.5)	11 (68.8)	5 (31.2)	0.250
≥26	13 (86.7)	2 (13.3)	9 (60)	6 (40)	0.125
Education					
≤12	15 (78.9)	4 (21.1)	12 (63.1)	7 (26.9)	0.250
≥13	12 (100)	0	8 (66.7)	4 (33.3)	0.125
Parity					
Nil	20 (90.9)	2 (9.1)	15 (68.2)	7 (31.8)	0.063
≥1	7 (77.8)	2 (21.2)	5 (55.5)	4 (44.5)	0.500
State of teeth					
Excellent/very good	16 (80)	4 (20)	13 (65)	7 (35)	0.250
Good/fair	11 (100)	0	7 (63.6)	4 (36.4)	0.125
Pain while chewing					
Present	6 (100)	0	3 (50)	3 (50)	0.250
Absent	21 (84)	4 (16)	17 (68)	8 (32)	0.125

*At-least once during the previous 7 days, ⁺McNemar test

There were certain study limitations. Being a pilot study, the number of participants was small, resulting in some baseline imbalance in spite of randomization. The unidirectional mode of text messaging and absence of tailoring of messages reduced the potential impact of the

mHealth intervention. Finally, there exist social challenges resulting in limited access to mobile phones among young women in conservative and patriarchal societies which potentially restrict the scalability of mHealth applications in these settings.

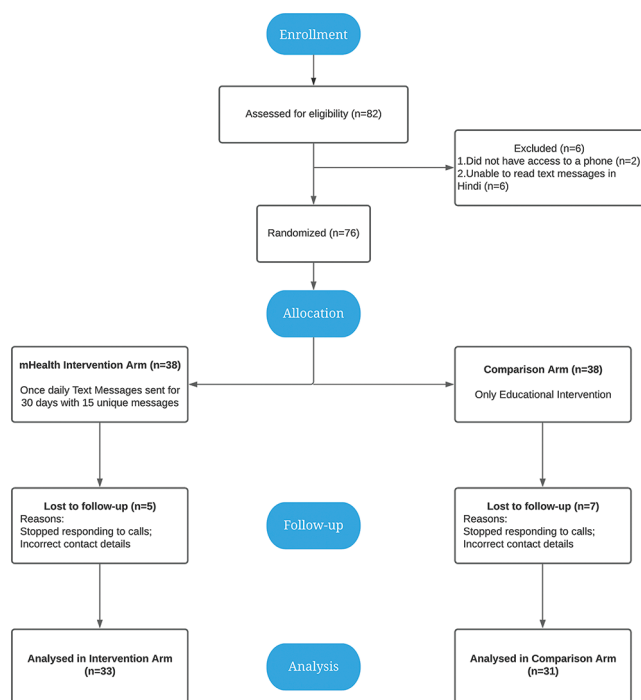


Figure 1: Flow diagram of the randomized control trial

The study has certain important implications for the National Oral Health Program and the Reproductive and Maternal Child Health Program of India. First, antenatal women attending primary care facilities should be provided oral health education since even a one-time didactic instruction by a health-care provider during a routine antenatal visit may be effective in improving oral hygiene in pregnant women. Second, the deployment of mHealth interventions should be considered for oral health promotion. Third, the enabling of referral services linking antenatal care with accessible and affordable dental care services warrants high prioritization in resource-constrained settings.

CONCLUSIONS

A mHealth-based daily text-message intervention for 1 month was not superior to a one-time brief didactic structured educational intervention for oral health promotion in antenatal women. Nevertheless, combining both the interventions improved the twice-brushing frequency measured over a 7-day recall period.

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Conflicts of interest

There are no conflicts of interest.

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